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TAKADA LABORATORY (November 1963~)

Head: Dr. Toshio Takada

The solid state chemistry and the inorganic synthesis have been studied under the direction of Prof. T. Takada since November in 1963. Since 1948, Prof. Takada has been principally engaged in the fundamental researches on the preparation and physical properties of transition metal oxides and hydroxides at Department of Chemistry of Kyoto University. His research has been succeeded and extended in this laboratory. It involves the microscopic examination of the decomposition of FeOOH, $Co(OH)_2$ and the preparation of FeOOH, Fe_2O_3 and some ferrites.

The main part of M. Kiyama's work is the study on the synthetic reaction of metallic ions in aqueous solution. The nucleation and crystal growth of FeOOH, Fe_2O_3 and ferrites ($MnFe_2O_4$, $ZnFe_2O_4$, $CoFe_2O_4$ etc.) are also investigated.

Dr. Y. Bando has studied the magnetic properties and the phase transitions of oxides and the nucleation and growth in the solid state or from vapor phase.

On the other hand, since 1966, Dr. T. Shinjo has applied the Mössbauer effect for the research of the magnetic materials and especially of magnetic fine particles.

The present researches of the laboratory can be classified as follows.

I. Studies on the preparation of transition metal oxides, hydroxides and ferrites

1) Precipitation of crystals from aqueous solution

In cases of FeOOH, Fe_2O_3, Fe_3O_4, $Mn(OH)_2$, Mn_3O_4, MnOOH, $Co(OH)_2$, CoOOH, and $Ni(OH)_2$, nucleation and growth of the crystals are investigated.

2) Crystal growth from vapor phase

Using metal chlorides as the vapor sources, Fe_2O_3 and ferrites were synthesized and mechanism of crystal growth was discussed. Trials of single crystal preparation have been carried out. The formation of Al thin films is also investigated.

3) Formation of crystal in solid state

Topotactic reaction, crystal growth of solid-solid reaction and sintering are studied in cases of hydroxides, oxides, and ferrite.

II. Studies on the physical and chemical properties of transition metal oxides and hydroxides

1) Characteristics of magnetic properties in fine particles

Magnetic structures of FeOOH, $Ni(OH)_2$ and $Co(OH)_2$ were clarified.

Magnetic measurements were made on the fine particles of FeOOH, $Ni(OH)_2$, $Co(OH)_2$, Fe_2O_3 and ferrites, and the results were discussed in relation with the particle size, shape and lattice imperfections.

2) Studies of metal ion distribution in ferrites

Metal ion distribution of $MnFe_2O_4$ and $ZnFe_2O_4$ precipitated from aqueous

solution was examined by NMR, Mössbauer effect and magnetic measurements.

3) Studies on corrosion of Al thin film

Corrosion of Al thin films prepared from vapor phase is examined from view point of lattice imperfection and microstructure.

III. Phase diagrams of oxides

Phase diagrams of a binary system of oxides ($Mn_{0.5}Zn_{0.5}Fe_2O_4$-CaO) and a ternary system of ($Mn_{0.5}Zn_{0.5}Fe_2O_4$-CaO-SiO_2) were determined.

IV. Mössbauer effect studies

By means of the Mössbauer effect on Fe^{57} nucleus, magnetic properties of various materials are being extensively studied and already some remarkable results were obtained.

On the samples of α-FeOOH and α-Fe_2O_3 fine particles, the Mössbauer effect was measured as a function of particle size and the superparamagnetism was studied as a dynamic phenomenon for the first time. Unusual magnetic behavior of fine particles of α-Fe_2O_3 was interpreted from the microscopic point of view.

The difference of magnetic properties among α-, β- and γ-FeOOH was made clear by the Mössbauer effect. They are all antiferromagnetic materials but the respective Néel temperatures are considerably different.

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